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A Formal Method for Selecting a Project Manager Based on Leadership Characteristics

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54. A FORMAL METHOD FOR SELECTING A PROJECT MANAGER BASED ON LEADERSHIP CHARACTERISTICS

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Abstract

Selecting the most suitable manager to lead a project is a non-trivial task especially if the need arises urgently. Our research presents a new method by which a new manager can be selected objectively by formally modeling the leadership characteristics, which are the core criteria of selection. The ideal characteristics sought by the company are modeled using a *Configuration Profile*, while the characteristics of each candidate manager are modeled using *Candidate Profile*. The value of each profile is computed and stored in a list. This list gets sorted and eventually the top candidate profile is selected. We show how to apply our methodology using the characteristics of leadership but any other arbitrary attributes, such as cultural or technical characteristics, can be used too.

Keywords

Quantitative assessment, selection algorithm, formalism, culture and leadership, project management.

1. Introduction

A number of studies tried to identify the impact of non- technical aspects of a project manager, such as cultural traits and leadership characteristics, on the total cost (Shepperd & Jorgensen 2007) of the project especially software development projects (Hamdan et al. 2005, Hamdan 2008). Researchers have repeatedly shown that lack of leadership support within a project is often a cause of ultimate failure (Futrell 2002). The leader of an organization has an essential role to play in setting the vision that the organization should embrace to move towards. To that end, a comprehensive study that aimed at identifying the importance of project leadership factors for estimating the cost of software development was conducted in the Arabian Gulf States (Hamdan et al. 2005). In that study a survey of software development projects within government departments was undertaken. The analysis of the survey highlighted several factors affecting cost estimation of software development projects, specifically leadership-related characteristics.

As a result, selecting a project manager based on leadership characteristics is important. The goal of this paper is to devise a non-subjective methodology by which the profiles of the candidate

managers are analyzed and ranked so that the best matching manager is selected. To achieve this goal, the ideal characteristics sought by the company (i.e., synopses in the publicized job opportunity) and the characteristics of the applying candidates should be modeled formally. This modeling transforms the hard-to-measure qualities of a manager to measurable qualities, which eventually allows administration decision makers rank their candidates and choose the top one systematically.

Attempting to model the managerial characteristics is not new (see for example Plekhanova 1999 & 2000). The authors tried to do so using some formalism called the profile theory. We have noticed some shortcomings in that formalism that we try to redress in this work. Briefly, we found that:

1. The profile theory does not pay enough attention to the implementation consequences. The suggested formalism is subject to non-trivial revisions once one starts thinking about the data structures involved. On the other hand, we define something called *configuration profile* that contains common data and constraints that candidate profiles should adhere to. As a result, we removed the pitfall of data redundancy.
2. Our definition is simpler, modular, and more resilient as it relies on the recursive definition of a profile. A profile can contain characteristics (the atomic data structures) or other profiles. This adds unlimited flexibility to accommodate almost any scenario with different degree of complexity.
3. In our formalism, the value of the profile is computed using simpler linear formula using the volume of a cube instead of the extra unnecessary complexity of computing the volume of a cylinder.
4. The pervious work's formalism overlooks the need to normalize the scales of different characteristic. This can lead to misleading calculations for the value of the overall profile as one attribute, due its inherit large scale, may influence others undesirably. Our formalism handles this normalization properly.

After presenting our formalism and models, we show how to apply our methodology using the leadership characteristics as an example, however, our methodology can be extended to any other managerial aspects of interest such as cultural (Schein 2004, Schneider et al. 2003) or technical characteristics (e.g., expertise in Web Services).

The rest of the paper is structured as follows. Section 2 briefly describes the leadership characteristics. Section 3 is the core section as it presents our models and formalism. Section 4 outlines our selection algorithm while Section 5 illustrates how to use it by an example. We conclude the paper by Section 6.

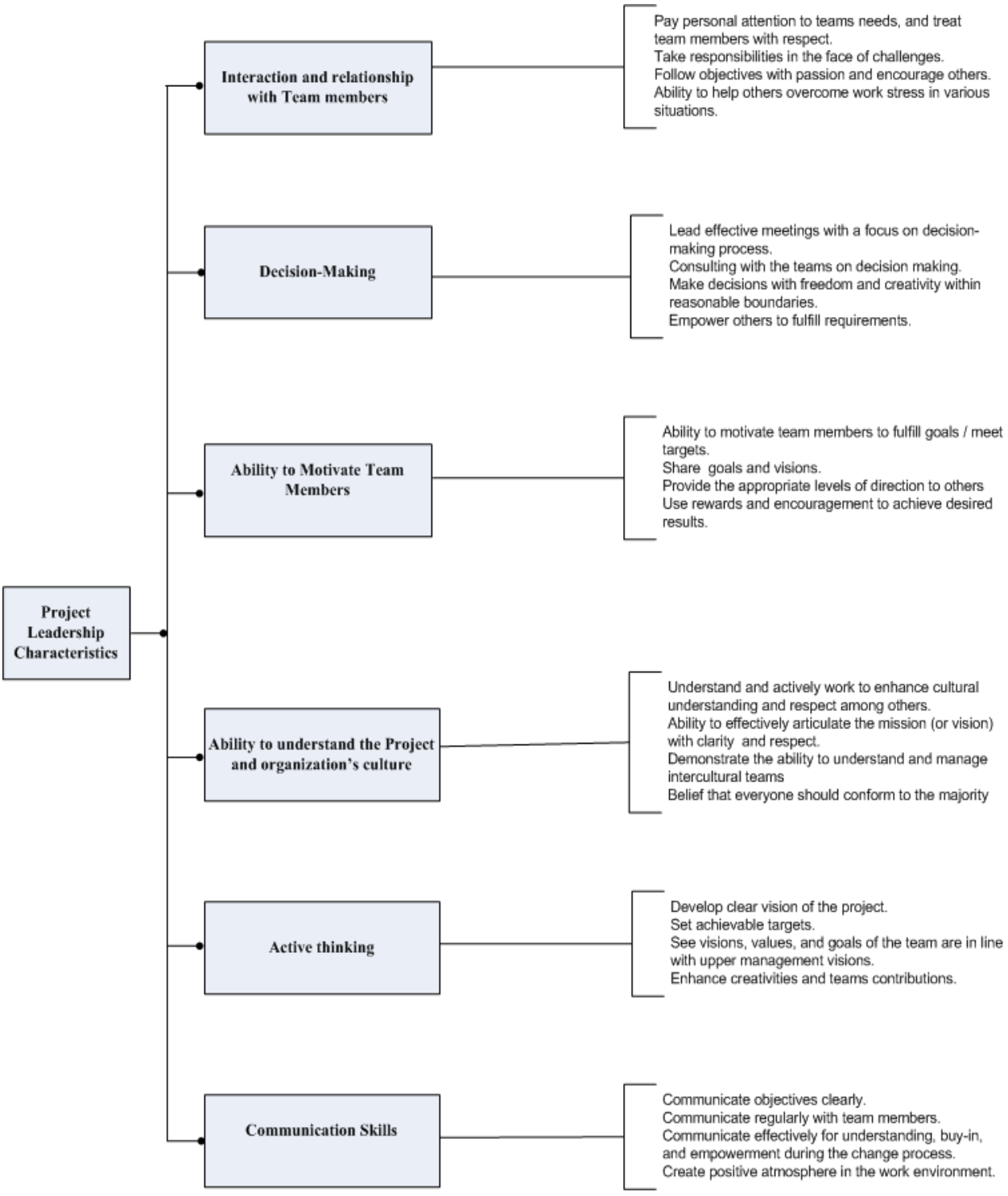

Figure 1: Leadership Characteristics
Source: (Hamdan 2008)

2. Leadership Characteristics

Based on a field study that surveyed a good number of software firms, (0Hamdan 2008) identified six characteristics of leadership that can have impact on the total cost of project execution and can differentiate the performance of a project manager from another:

- Interactions/Relations with team members.
- Decision making.
- Ability to motivate team members.
- Ability to understand organization's culture.
- Active thinking.
- Communication skills.

Figure 1 lists these characteristics and describe them in more details. The study also helped associating each characteristic with a specific weight of significance and influence on the project. Each candidate manager should be rated against each characteristic on a scale from 1 to 9 that reflects the experience in years. In addition, and for each characteristic, the competence of each candidate should be assessed (1=beginner, 2=intermediate, 3=advanced) as the experience does not necessarily reflect the possessed skill.

In order to be able to rank a list of candidates, each having different qualities under each characteristic, we adopt a quantitative approach. The only constant inputs to this ranking system are the weights that we assign to each characteristic. These weights are not hypothetical but rather real and obtained empirically by conducting surveys and interviews with managers and employees from the industry (Hamdan 2008).

3. Modeling Leadership Characteristics

Let's consider the following typical scenario. A company is in an urgent need for a manager for some software development project. The company has a set of criteria or characteristics by which the leadership is defined and evaluated. Candidate managers should be assessed against these characteristics. The manager with the highest profile value is the one that should be selected. To formalize the problem above, we need to define the following:

- *Characteristic*: it is the atomic data structure we deal with. Example of a characteristic is "Communication Skill". Abstractly, we deal with each characteristic as a factor or a dimension.
- *Configuration Profile*: it is the setup profile in which the company dictates its minimum requirements and constraints for each characteristic. Therefore, this configuration profile consists of a set of characteristics, each is defined by three attributes: a range for the *experience*, a range for the *competence*, and a *weight* that reflects how important this characteristic is to the company.
- *Candidate Profile*: it describes the candidate manager and contains an assessment for her against each leadership characteristic listed in the Configuration Profile of the company. Ultimately, we need to rank candidate profiles in order to choose the top one.

	e′		c′		
Leadership Characteristic	*Min*	*Max*	*Min*	*Max*	*Weight*
Interactions/Relationships	2	9	1	3	0.1
Decision Making	5	9	2	3	0.3
Motivation	2	9	1	3	0.08
Understanding Organization Culture	2	9	1	3	0.2
Active Thinking	2	9	1	3	0.07
Communication Skills	2	9	2	3	0.25
					1.00

Figure 2: An example of a Configuration Profile

Next, we define each profile formally and with a support of an illustrative example. We start by defining the Configuration Profile.

3.1 Configuration Profile ($\mathbb{P}'$)

Figure 2 shows an example of a company's configuration profile. A profile consists of a set of characteristics.

$$\mathbb{P}' = \{\mathbb{C}_i' : where\ \mathbb{C}_i'\ is\ characteristic, \quad 1 \leq \ i \ \leq n\}$$

n is the number of characteristics that define leadership. In this context, each Characteristic ($\mathbb{C}'$) is defined by a tuple:

$$\mathbb{C}' = < id', e', c', w' >$$

Where

- id' identifies the characteristic under consideration. For example, id' ="Communication Skills".
- $e' = [e'_{min}, e'_{max}]$ and denotes the range of *experience* a person must have, measured in time units (e.g., years). $e^{min} \geq 0$.
- $c' = [c'_{min}, c'_{max}]$ and denotes the range (or levels) of *competence* a person has under that characteristic. Two persons might have the same number of years of experience that makes them both qualified for the managerial position but we are still interested in distinguishing between them by assessing their competence under the same depth of experience.
- And $w' = weight \in [0,1]$ denotes the weight of this characteristic relative to other characteristics and subject to the condition that

$$\sum_{i=1}^{i=n} w_i' = 1$$

	Candidate I			Candidate II			Candidate III		
Characteristic (id)	*e*	*c*	*v*	*e*	*c*	*v*	*e*	*c*	*v*
Interactions/Relationships	6.5	3	0.069	7.1	3	0.076	6.5	3	0.069
Decision Making	5.3	2	0.039	8.0	2	0.120	5.3	2	0.039
Motivation	6.3	3	0.053	6.6	3	0.056	6.3	1	0.018
Understanding Organization Culture	6.8	3	0.145	6.8	2	0.097	6.8	1	0.048
Active Thinking	6.5	2	0.032	6.4	3	0.047	6.5	3	0.048
Communication Skills	6.6	3	0.175	7.1	3	0.191	6.6	3	0.175
			0.51			0.59			0.40

Figure 3: Examples of three candidate profiles

That is, the summation of all weights of characteristics in a configuration profile should not exceed 1.

As an example, one of the characteristics shown in the configuration profile of Figure 2 is titled "Communication Skills". The range of the required experience is between 2 to 9 years. The level must be between 2 (intermediate) and 3 (advanced). This characteristic has a high weight (0.25) in comparison with others.

3.2 Candidate Profile ($\mathbb{P}$)

Figure 3 shows three examples of candidate profiles that are seeking a position at the company of the configuration profile shown in Figure 2. As we can see, a candidate profile ($\mathbb{P}$) consists of a set of characteristics that describe the values that each candidate has.

$$\mathbb{P} = \{\mathbb{C}_i : where\ \mathbb{C}_i\ is\ characteristic, \quad 1 \leq i \leq n\}$$

n is the number of characteristics that appeared in the configuration profile ($\mathbb{P}'$). In the candidate profile context, each Characteristic ($\mathbb{C}$) is defined by a tuple:

$$\mathbb{C} = < id', e, c, v >$$

Where

- id' corresponds to the leadership characteristic listed in the configuration profile (e.g., id' ="Communication Skills").
- e denotes the experience the candidate has. It is obtained from the candidate's resume or her submitted job application.
- c denotes the level of competence the candidate has. It is obtained from the candidate's resume or her submitted job application.

- v denotes the value of the characteristic given the above attributes. It is a derived value that quantitatively summaries the characteristic under investigation:

$$v = e \times c \times w'$$

w' denotes the weight assigned to the characteristic under the configuration profile as explained earlier. However, since *e*, *c*, and w' have different scales, we need to normalize them on a scale of [0, 1]. Normalization here is needed in order to avert undesired influence of one characteristic to others by its too large (or small) scale. Weight is already normalized as its range is always from 0 to 1. For experience and competence, we apply range normalization in order to obtain the new value of each:

$$e = \frac{e - e'_{min} + 1}{e'_{max} - e'_{min} + 1}$$

And for the competency

$$c = \frac{c - c'_{min} + 1}{e'_{max} - c'_{min} + 1}$$

Therefore, and after getting the new, normalized *e* and *c*, we have

$$v = e \times c \times w'$$

Which means the more experience, the more competence, and the more weight a characteristic has, the bigger its value is.

Finally, the value of the overall profile ($\mathbb{P}_v$) is defined by summing up the values of its comprising characteristics:

$$\mathbb{P}_v = \sum_{i=1}^{i=n} v_i$$

Note that in addition to atomic characteristics, a profile can recursively contain other nested profiles. This should enable modeling a hierarchy of characteristics with high scalability.

4. Selection Algorithm

The formalism described above puts the foundation for devising a simple algorithm for selecting the most suitable candidate profile that matches the announced company job position. Figure 4 depicts this algorithm. First, the announced company's opening should be formalized as a configuration profile. Then, and for each candidate manager, a candidate profile is constructed. Before going into any further processing, some candidate profiles get

- *Construct the configuration profile* $\mathbb{P}'$
- *For each candidate manager i:*
  - *Construct* $\mathbb{P}^i$
  - *Filter out* $\mathbb{P}^i$ *upon any range violation*
  - *Compute* $\mathbb{P}_v$
- *Sort the list* $\mathbb{P}^i$ *based on their* $\mathbb{P}_v$.
- *Select the top* $\mathbb{P}$ *in the sorted list.*

Figure 4: Candidate Selection Algorithm

excluded from the beginning due to disqualification (e.g., not respecting the minimum number of years of experience). For the rest, the value of the profile is computed and stored in a list. This list is eventually sorted where the top value corresponds to the top candidate that should be selected.

5. Illustrative Example

To put the proposed profile formalism and the selection algorithm into perspective, we use an illustrative scenario where the configuration profile of the company is shown in Figure 2. It outlines the minimum and maximum limits for each leadership characteristic, for both the experience and competence criteria. In general, the experience ranges from two to nine years while the competence ranges from one to three: one denotes beginners, two refers to intermediate skills, and three refers to advanced skillful candidates. In addition, each characteristic is associated with a special weight of significance obtained through a field study (Hamdan 2008). As seen, decision making and communication skills have high weights in comparison with others.

In light of this configuration profile, we need to select the best matching manager among the three candidates whose profiles are shown in Figure 3. Using the selection algorithm, we start reducing the candidate set by factoring out the managers whose characteristics violate the range constraints of at least one characteristic in the configuration profile. In that respect, candidate (III) should be excluded because the minimum competence level constraint is not satisfied; the candidate has level one under the *Motivation* and *Understanding Organization's Culture* characteristics while the minimum acceptable level is two ($c'_{min} = 2$ in the configuration profile).

Therefore, the competition is confined to candidates (II) and (III). By sorting the two profiles based on their values, we conclude that the candidate (II) should be selected because the value of her profile is the highest (0.59 > 0.51).

6. Conclusions

This work is built on the premise shown by other researchers that leadership characteristics have their influence on the performance of the project (Fairholm 1991) and its final total cost (Shepperd & Jorgensen 2007). Our work focuses on devising a formal way by which a company can systematically choose the best manager in light of the leadership characteristics. We presented formal models and a selection algorithm for that purpose. The idea is illustrated using an example whose parameters (weights of characteristics) are obtained empirically.

We believe that our methodology can be generalized to the standard hiring process adopted by human resources department. In fact, the leadership characteristics are mere example criteria otherwise any hiring criteria, e.g., cultural characteristics (Schein 2004, Schneider et al. 2003) or technical skills (e.g., knowing C++), can be adopted too. As a prototype, we used simple Excel sheets to build our models, however, a full-fledged software can be built using the ideas we proposed in this paper.

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